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RESPONSE OF WYETHIA TO 2, 4-D

A. B. Evanko
Division of Range Research

INTRODUCTION

Wyethia amplexicaulis, commonly known as mulesears wyethia, green dock, mountain wyethia, and black sunflower, frequently dominates large areas of western range almost to the complete exclusion of other vegetation. This species is the most common and widespread member of the Wyethia genus which belongs to the sunflower family. The genus is represented by 15 species confined largely to the western portions of the United States and southwestern Canada. Mulesears wyethia is adapted to a wide variety of sites in southwestern Montana. It occurs in small patches and areas up to several hundred acres in extent.

Palatability of this species is generally low for all classes of livestock, but sheep eat more of it than cattle. The flower heads are taken more readily than the leaves although when young and tender they too are eaten by livestock, deer, and elk. After flowering the plants become brown and dry. The deep, tuberous taproot enables mulesears to withstand grazing and trampling. Propagation is entirely by seed, with probably some increase in stand densities by vegetative enlargement of clumps. "Old-timers" in the Forest Service noted the occurrence of mulesears in the Upper Ruby River drainage of southwestern Montana as early as 1917. At that time there were only occasional small patches on the range but these have increased to such an extent that ranges once capable of producing high yields of palatable forage are now of little or no grazing value. A recent survey of the Upper Ruby River portion of the Sheridan Ranger District, Beaverhead National Forest, indicated that 6,238 acres of summer range are presently occupied by dense stands of mulesears.

Numerous chemical herbicides have proven lethal to many noxious plants. Until recently, however, these had not been tested as a means of controlling mulesears. In 1949 a study was initiated at the Vigilante Experimental Range on the Beaverhead National Forest to determine the effectiveness of 2, 4-dichlorophenoxyacetic acid (2, 4-D) in disturbing the growth processes and ultimately causing death of mulesears. Comparison of the relative effects of different concentrations of 2, 4-D, on mulesears and associated species, with both water and diesel oil carriers was included.

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DESCRIPTION OF THE AREA

The study area was located in a mulesears-infested high mountain meadow that because of proximity to water and timber was in the past and currently is heavily grazed by cattle. Elevation was about 7,300 feet, the soil a heavy clay loam, and the exposure westerly. Total vegetative density averaged 0.45 of which 59 percent was mulesears, 14 percent other weeds, including species of Geranium, Potentilla, Taraxacum, Trifolium, Achillea, Allium, Polygonum, and Collinsia, and 27 percent grasses and grasslike plants consisting of species of Poa, Agropyron, Agrostis, and Carex.

STUDY DESIGN AND TREATMENT

Five blocks each with three sets of paired plots were laid out on a representative portion of the area. Pairing of plots was used to minimize variation in slope, soil fertility, vegetative cover, and other factors. Individual plots were 3 by 5 feet in size. Two carriers, water and diesel oil, and two concentrations of 2, 4-D, 6,000 and 10,000 parts ("Weed No More," a commercial product containing 40 percent isopropyl ester of 2, 4-D) per million parts (ppm) of carrier, were used as contact sprays. For each tier of 15 plots the carrier and the 2, 4-D concentration used on individual treated plots within blocks were determined by random selection, figure 1. The arrangement also provided two controls or untreated plots for each block.

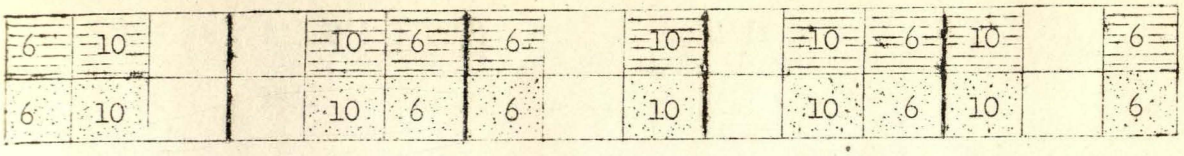
The area was sprayed on July 11, 1949, using a Banta-Driscoll portable sprayer equipped with a high fog nozzle. The main effort was directed toward thoroughly wetting the aerial portions of the mulesears plants with little regard for the coverage of other vegetation.

At the time of spraying an estimated 90 percent of the mulesears plants were beyond the bloom stage. Other developmental stages such as vegetative, bud, and bloom were also represented. Other weeds were near or in the bloom stage except dandelion which was well past blooming.

RESULTS

Mulesears Wyethia

Frequent observations during the remainder of July and early August indicated that the sprayed mulesears plants turned brown and began to dry within a week after spraying. Some stem curvature of mulesears, Geranium, and Potentilla, was also evident soon after spraying. By the first week in August the treated mulesears plants had almost completely disintegrated. By July 10, 1950, one year after treatment, mulesears had been almost completely eliminated from the plots treated with 2, 4-D, table 1, figure 2. Statistical analyses (Appendix, table A-1) showed that the chances were more than 99 in a hundred that the kill was due to the 2, 4-D treatment. Water and oil mixtures of 2, 4-D were



LEGEND:

6 Plot treated with 6,000 ppm 2, 4-D in diesel oil.

10 Plot treated with 10,000 ppm, 2, 4-D in water.

Untreated (control) plot.

Only 2 blocks here. Treatment is confounded with position See also Fig 2.

Figure 1. - Field study set-up showing plot and treatment arrangement.

equally effective in disturbing the growth processes and causing death of mulesears. This was also true for the two concentrations of 2, 4-D used; both being equally effective.

Grasses

Density of perennial grasses was not affected by either concentration of 2, 4-D. Diesel oil as a carrier, however, was apparently toxic to the grasses. In order to test the effect of oil on grasses as compared to water and no treatment (control), the data were regrouped on this basis and tested by covariance analysis (Appendix, table A-2). This method was considered most applicable since grass density on the three groups of plots in 1950 was known to have a direct relationship to pre-treatment, 1949, grass density. Furthermore, grass density was not comparable on the plot groups in 1949. The method minimizes that part of the 1950 density differences between treatment groups assignable to these factors and provides a more comparable basis for evaluating treatment effect on grass density.

Adjusted grass density means for control, water, and oil groups of plots were 0.15, 0.18, and 0.10, respectively. Little difference in grass density was found between the untreated (control) group of plots and those treated with water. However, a real difference in density of grasses was evident when the oil group was compared with the control or water group. In the water and oil comparison, chances of the differences in grass density being real and not due to chance were 99 out of a 100; in the control and oil comparison, 90 out of a 100 (Appendix, table A-2).

Since 2, 4-D almost completely eliminated mulesears from the study plots, it is reasonably certain that competition between grasses and mulesears

Table 1. - Average percent density of mulesears, grasses, and other weeds in 1949 and 1950 on sprayed and unsprayed plots

Class of vegetation	Control-untreated		Water carrier				Control-untreated		Oil carrier			
			6,000 ppm		10,000 ppm				6,000 ppm		10,000 ppm	
	1949	1950	1949	1950	1949	1950	1949	1950	1949	1950	1949	1950
Wyethia	24	32	29	0	30	0	31	47	20	0	22	3
Grasses	11	18	13	19	13	20	8	6	14	15	11	7
Other weeds	8	22	5	7	6	7	5	9	7	14	6	9

was correspondingly reduced and grass densities might accordingly increase. However, in 1950, one year after treatment, such response was not apparent. Comparison of adjusted grass density means for the untreated plots and the water group, representing 6,000 and 10,000 ppm 2, 4-D mixtures, indicated little increase in grass density for the latter group on which mulesears had been eliminated. This small difference was not statistically significant. Apparently the release from competition afforded the grasses through mulesears reduction was not sufficient or the time for response, one year, was too short to permit any appreciable increase in grass density.

Other weeds

The two concentrations of 2, 4-D in mixture with water or oil reduced perennial weed cover; 10,000 ppm caused the greatest reduction. On 16 of the 20 plots treated, Geranium, Potentilla, and Taraxacum densities were less one year after treatment. The density of these species in 1950 on the control plots remained the same or increased somewhat over 1949. Annual weed cover increased about equally on all plots regardless of treatment.

not broken out in Table 1

SUMMARY

Spraying mulesears wyethia-infested ranges in southwestern Montana in mid-July 1949, with 6,000 and 10,000 parts of 2, 4-D acid per million parts of water or diesel oil, almost completely eliminated the mulesears. The plants were mostly past the bloom stage at the time of treatment. The two spray concentrations were equally effective in reducing the mulesears' density. One year after treatment perennial grasses showed no increase in density assignable to reduced competition following removal of mulesears. A reduction of total perennial weed cover was caused by both concentrations of 2, 4-D. Annual weed cover the year following treatment was apparently unaffected by any of the treatments.

Diesel oil as a carrier for 2, 4-D was not superior to water. Grass density, however, was reduced by the toxic action of the oil. This effect did not appear to be operative on weeds.

Figure 2. - Views of mulesears study plots: Left, before spraying, July 1949; Right, one year following spraying - surviving mulesears are on untreated (control) plots.

These results are from one year's study of the effects of 2, 4-D sprays on mulesears. While indicative of the control that may be expected with 2, 4-D, weather and/or growing conditions in other years may vary the effects observed in this study.

APPENDIX

Table A-1. - Analysis of variance of change in mulesears density, 1950 densities expressed as percentages of 1949 densities, and comparisons of treatment mean differences

Source of variance	df	Mean square	"F"
Treatment	4	18,950	16.21**
Blocks	~~4~~ 2	283	0.24
Treatments x blocks	~~16~~ 8	1,169	
Total	24 ~~14~~		

Treatment comparisons	Difference in mean change [2/]	"K" [1/]
Control and 6,000 ppm, water	142.4	12.135**
Control and 10,000 ppm, water	142.6	12.162**
Control and 6,000 ppm, oil	142.0	12.073**
Control and 10,000 ppm, oil	132.8	9.497**
6,000 ppm, water and 10,000 ppm, water	0.2	0.223
6,000 ppm, water and 6,000 ppm, oil	- 0.4	0.310
6,000 ppm, water and 10,000 ppm, oil	- 9.6	1.251
10,000 ppm, water and 6,000 ppm, oil	- 0.6	0.500
10,000 ppm, water and 10,000 ppm, oil	- 9.8	1.280
6,000 ppm, oil and 10,000 ppm, oil	- 9.2	1.193

**Significant beyond the 1 percent level.

1/ Relative deviate.
2/ Mean change of second item minus mean change of first item.

Table A-2. - Covariance analysis of perennial grass density and comparisons of treatment mean differences, 1950

Source of variation	Adjusted values df	Mean square	"F"
Treatment (carrier)	2	159	3.75*
Error	26	42.35	
Total	28		

Comparison	Mean difference	"t"
Control and water	.02836	0.9572
Control and oil	.05020	1.7036°
Water and oil	.07856	2.6980**

*Significant to the 4 percent level.
°Significant to the 10 percent level.
**Significant to the 1 percent level.

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